Amendment to the Claims:

This listing of claims replaces all prior versions, and listings, of claims in the application:

1. (original) A method comprising:

generating a three dimensional model of an environment from range sensor information representing a height field for the environment;

tracking orientation information of at least one image sensor in the environment with respect to the three dimensional model in real-time;

projecting real-time video imagery information from the at least one image sensor onto the three dimensional model based on the tracked orientation information; and

visualizing the three dimensional model with the projected real-time video imagery.

2. (currently amended) A ~~The~~ method ~~of claim 1,~~ comprising:

generating a three dimensional model of an environment from range sensor information representing a height field for the environment;

tracking orientation information of at least one image sensor in the environment with respect to the three dimensional model in real-time;

projecting real-time video imagery information from the at least one image sensor onto the three dimensional model based on the tracked orientation information; and

visualizing the three dimensional model with the projected real-time video imagery;

wherein generating the three dimensional model comprises identifying a structure in the range sensor information, identifying different sections of the structure, selecting geometric primitives for the different sections of the structure based at least in part on input from a person regarding different shapes of the different sections, and parametric fitting of the geometric primitives to the range sensor information.

3. (currently amended) The method of claim 2, wherein ~~generating the three dimensional model further comprises:~~

~~identifying a structure in the range sensor information;~~

the selecting ~~a set of~~ geometric primitives comprises selecting geometric primitives from a group[[,]] including a sphere primitive and a cuboid primitive; and ~~superquadratic, to use in the parametric fitting with respect to the identified structure based on a shape of the structure~~

the parametric fitting comprises performing constrained best fitting of the geometric primitives to the range sensor

information.

4. (original) The method of claim 2, wherein the at least one image sensor comprises multiple image sensors, and generating the three dimensional model further comprises refining the three dimensional model based on object surfaces mapped from images acquired by the image sensors.

5. (original) The method of claim 1, wherein generating the three dimensional model further comprises projecting and resampling points in the range sensor information onto a regular grid at a user-defined resolution to produce the height field.

6. (original) The method of claim 5, wherein generating the three dimensional model further comprises processing the height field using hole-filling and tessellation to generate a triangle mesh representation of the three dimensional model.

7. (original) The method of claim 2, wherein the range sensor information comprises light detection and ranging (LIDAR) sensor data from an active airborne laser sensor.

8. (original) The method of claim 1, wherein tracking orientation information comprises tracking position and orientation information of the at least one image sensor by estimating a camera pose based at least in part on three

dimensional parameters of point and line structures visible in the camera image, and projecting real-time video imagery information comprises projecting real-time video imagery information from the at least one image sensor onto the three dimensional model based on the tracked orientation information.

9. (original) The method of claim 8, wherein tracking position and orientation information of the at least one image sensor further comprises processing data from a tracking sensor system that integrates visual input, global navigational satellite system receiver input, and inertial orientation sensor input.

10. (original) The method of claim 1, wherein the at least one image sensor comprises multiple image sensors, and projecting the real-time video imagery information comprises projecting multiple video streams from the multiple image sensors onto the three dimensional model.

11. (original) The method of claim 1, wherein projecting the real-time video imagery information comprises:

generating a depth map image from a video sensor viewpoint; and

projective texture mapping the real-time video imagery information onto the three dimensional model conditioned upon

visibility as determined from the generated depth map image.

12. (currently amended) A ~~The~~ method ~~of claim 11,~~ comprising:

generating a three dimensional model of an environment from range sensor information representing a height field for the environment;

tracking orientation information of at least one image sensor in the environment with respect to the three dimensional model in real-time;

projecting real-time video imagery information from the at least one image sensor onto the three dimensional model based on the tracked orientation information; and

visualizing the three dimensional model with the projected real-time video imagery;

wherein projecting the real-time video imagery information comprises generating a depth map image from a video sensor viewpoint, and projective texture mapping the real-time video imagery information onto the three dimensional model conditioned upon visibility as determined from the generated depth map image; and

wherein generating the depth map image and projective texture mapping the real-time video imagery information are performed using a one-pass approach on graphics hardware that

supports SGI OpenGL extensions.

13. (original) The method of claim 1, wherein visualizing the three dimensional model comprises:

video-projecting onto a display screen using a stereo video-projector; and

coupling a rendering viewpoint to a user's head position using data from a tracker.

14. (original) An augmented virtual environment system comprising:

a model construction component that generates a three dimensional model of an environment from range sensor information representing a height field for the environment;

a dynamic fusion imagery projection component that projects real-time video imagery information from at least one image sensor onto the three dimensional model based on orientation information of the at least one image sensor tracked in the environment with respect to the three dimensional model in real-time; and

a visualization sub-system that visualizes the three dimensional model with the projected real-time video imagery.

15. (original) The system of claim 14, wherein the at least one image sensor comprises multiple image sensors.

16. (original) The system of claim 15, wherein the real-time video imagery information comprises pre-recorded real-time video imagery information.

17. (original) The system of claim 15, wherein the dynamic fusion imagery projection component bases the real-time video imagery projection on a viewpoint separate from viewpoints associated with the multiple image sensors.

18. (currently amended) <u>An</u> ~~The~~ <u>augmented virtual environment</u> system ~~of claim 14,~~ <u>comprising:</u>

<u>a model construction component that generates a three dimensional model of an environment from range sensor information representing a height field for the environment;</u>

<u>a dynamic fusion imagery projection component that projects real-time video imagery information from at least one image sensor onto the three dimensional model based on orientation information of the at least one image sensor tracked in the environment with respect to the three dimensional model in real-time; and</u>

<u>a visualization sub-system that visualizes the three dimensional model with the projected real-time video imagery;</u>

wherein the model construction component performs operations comprising:

identifying a structure in the range sensor information;

identifying different sections of the structure;

selecting ~~a set of~~ geometric primitives~~, including a superquadratic,~~ for the different sections of the structure based at least in part on input from a person regarding different shapes of the different sections ~~a shape of the structure~~; and

parametric fitting of the selected geometric primitives to the range sensor information.

19. (original) The system of claim 18, wherein the operations further comprise:

projecting and resampling points in the range sensor information onto a regular grid at a user-defined resolution to produce the height field; and

processing the height field using hole-filling and tessellation to generate a triangle mesh representation of the three dimensional model.

20. (original) The system of claim 14, wherein the at least one image sensor comprises multiple image sensors, and the system further comprises a model refinement component that refines the three dimensional model based on object surfaces mapped from images acquired by the image sensors.

21. (original) The system of claim 14, further comprising a tracking sensor system that integrates visual input, global navigational satellite system receiver input, and inertial orientation sensor input to obtain position and orientation information of the at least one image sensor, and the dynamic fusion imagery projection component projects the real-time video imagery information based on the position and orientation information.

22. (currently amended) An ~~The~~ augmented virtual environment system ~~of claim 14,~~ comprising:

a model construction component that generates a three dimensional model of an environment from range sensor information representing a height field for the environment;

a dynamic fusion imagery projection component that projects real-time video imagery information from at least one image sensor onto the three dimensional model based on orientation information of the at least one image sensor tracked in the environment with respect to the three dimensional model in real-time; and

a visualization sub-system that visualizes the three dimensional model with the projected real-time video imagery;

wherein the visualization sub-system comprises the dynamic fusion imagery projection component and graphics hardware that

supports SGI OpenGL extensions, and uses a one-pass approach on the graphics hardware to generate a depth map image from a video sensor viewpoint and projective texture map the real-time video imagery information to project the real-time video imagery information conditioned upon visibility as determined from the generated depth map image.

23. (original) The system of claim 14, wherein the visualization sub-system comprises:

a stereo video-projector; and

a tracker.

24. (cancelled)

25. (currently amended) The method of claim 29 ~~24~~, wherein the surface comprises a two dimensional surface.

26. (original) The method of claim 25, wherein placing the two dimensional surface comprises:

casting a ray from an optical center, corresponding to the real-time video imagery information, to a bottom point of the moving region in an image plane in the three dimensional model; and

determining a position, an orientation and a size of the two dimensional surface based on the ray, a ground plane in the

three dimensional model, and the moving region.

27. (cancelled)

28. (cancelled)

29. (currently amended) A ~~The~~ method ~~of claim 28,~~ comprising:

obtaining a three dimensional model of an environment;

identifying in real time a region in motion with respect to a background image in real-time video imagery information from at least one image sensor having associated position and orientation information with respect to the three dimensional model, the background image comprising a single distribution background dynamically modeled from a time average of the real-time video imagery information;

placing a surface that corresponds to the moving region in the three dimensional model;

projecting the real-time video imagery information onto the three dimensional model, including the surface, based on the position and orientation information; and

visualizing the three dimensional model with the projected real-time video imagery;

wherein identifying a region in motion in real time comprises subtracting the background image from the real-time

video imagery information, identifying a foreground object in the subtracted real-time video imagery information, validating the foreground object by correlation matching between identified objects in neighboring image frames, and outputting the validated foreground object;

wherein identifying a foreground object comprises identifying the foreground object in the subtracted real-time video imagery information using a histogram-based threshold and a noise filter;

wherein identifying a region in motion in real time further comprises estimating the background image by modeling the background image as a temporal pixel average of at least five recent image frames in the real-time video imagery information.

30. (currently amended) The method of claim 29 ~~24~~, further comprising tracking the position and orientation information of the at least one image sensor in the environment with respect to the three dimensional model in real-time.

31. (original) The method of claim 30, wherein obtaining a three dimensional model of an environment comprises generating the three dimensional model of the environment from range sensor information representing a height field for the environment.

32. (cancelled)

33. (currently amended) The system of claim 37 ~~32~~, wherein the surface comprises a two dimensional surface.

34. (original) The system of claim 33, wherein the object detection and tracking component places the two dimensional surface by performing operations comprising:

casting a ray from an optical center, corresponding to the real-time video imagery information, to a bottom point of the moving region in an image plane in the three dimensional model; and

determining a position, an orientation and a size of the two dimensional surface based on the ray, a ground plane in the three dimensional model, and the moving region.

35. (cancelled)

36. (cancelled)

37. (currently amended) An ~~The~~ augmented virtual environment system ~~of claim 36,~~ comprising:

an object detection and tracking component that identifies in real time a region in motion with respect to a background image in real-time video imagery information from at least one image sensor having associated position and orientation information with respect to a three dimensional model, the

background image comprising a single distribution background dynamically modeled from a time average of the real-time video imagery information, and places a surface that corresponds to the moving region with respect to the three dimensional model;

a dynamic fusion imagery projection component that projects the real-time video imagery information onto the three dimensional model, including the surface, based on the position and orientation information; and

a visualization sub-system that visualizes the three dimensional model with the projected real-time video imagery;

wherein the object detection and tracking component identifies the moving region by performing operations comprising subtracting the background image from the real-time video imagery information, identifying a foreground object in the subtracted real-time video imagery information, validating the foreground object by correlation matching between identified objects in neighboring image frames, and outputting the validated foreground object;

wherein identifying a foreground object comprises identifying the foreground object in the subtracted real-time video imagery information using a histogram-based threshold and a noise filter; and

wherein identifying a region in motion in real time further comprises estimating the background image by modeling the

background image as a temporal pixel average of at least five recent image frames in the real-time video imagery information.

38. (currently amended) The system of claim 37 ~~32~~, further comprising a tracking sensor system that integrates visual input, global navigational satellite system receiver input, and inertial orientation sensor input to obtain the position and the orientation information associated with the at least one image sensor in real time in conjunction with the real-time video imagery.

39. (original) The system of claim 38, further comprising a model construction component that generates the three dimensional model of an environment from range sensor information representing a height field for the environment.

40. (original) A machine-readable medium embodying information indicative of instructions for causing one or more machines to perform operations comprising:

generating a three dimensional model of an environment from range sensor information representing a height field for the environment;

tracking orientation information of at least one image sensor in the environment with respect to the three dimensional model in real-time;

projecting real-time video imagery information from the at least one image sensor onto the three dimensional model based on the tracked orientation information; and

visualizing the three dimensional model with the projected real-time video imagery.

41. (currently amended) A ~~The~~ machine-readable medium ~~of claim 40,~~ embodying information indicative of instructions for causing one or more machines to perform operations comprising:

generating a three dimensional model of an environment from range sensor information representing a height field for the environment;

tracking orientation information of at least one image sensor in the environment with respect to the three dimensional model in real-time;

projecting real-time video imagery information from the at least one image sensor onto the three dimensional model based on the tracked orientation information; and

visualizing the three dimensional model with the projected real-time video imagery;

wherein generating the three dimensional model comprises:

identifying a structure in the range sensor information;

identifying different sections of the structure;

selecting ~~a set of~~ geometric primitives~~, including a~~

~~superquadratic,~~ for the different sections of the structure based at least in part on input from a person regarding different shapes of the different sections ~~a shape of the structure~~; and

parametric fitting of the selected geometric primitives to the range sensor information.

42. (cancelled)

43. (cancelled)

44. (cancelled)

45. (new) The method of claim 3, wherein

the selecting geometric primitives comprises selecting geometric primitives from the group including the sphere primitive, the cuboid primitive, a hollow-cuboid primitive, and a roof primitive, the roof primitive comprising connected symmetric slope primitives; and

the parametric fitting comprises performing constrained best fitting of the geometric primitives to the range sensor information without ground plan information for the structure.

46. (new) The system of claim 18, wherein

the selecting geometric primitives comprises selecting geometric primitives from a group including a sphere primitive

and a cuboid primitive; and

the parametric fitting comprises performing constrained best fitting of the geometric primitives to the range sensor information.

47. (new) The system of claim 46, wherein

the selecting geometric primitives comprises selecting geometric primitives from the group including the sphere primitive, the cuboid primitive, a hollow-cuboid primitive, and a roof primitive, the roof primitive comprising connected symmetric slope primitives; and

the parametric fitting comprises performing constrained best fitting of the geometric primitives to the range sensor information without ground plan information for the structure.

48. (new) The machine-readable medium of claim 41, wherein

the selecting geometric primitives comprises selecting geometric primitives from a group including a sphere primitive and a cuboid primitive; and

the parametric fitting comprises performing constrained best fitting of the geometric primitives to the range sensor information.

49. (new) The machine-readable medium of claim 48, wherein

the selecting geometric primitives comprises selecting

geometric primitives from the group including the sphere primitive, the cuboid primitive, a hollow-cuboid primitive, and a roof primitive, the roof primitive comprising connected symmetric slope primitives; and

the parametric fitting comprises performing constrained best fitting of the geometric primitives to the range sensor information without ground plan information for the structure.